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(71) Applicant (for all designated States except US): NOKIA CORPORATION [FI/FI]; Keilalahdentie 4, FIN-02150 Espoo (FI).

(72) Inventors; and

(75) Inventors/Applicants (for US only): HSU, Liangchi [US/US]; 2614 Tillman Drive, Arlington, TX 76006 (US). LE, Khiem [US/US]; 607 St. Andrews Place, Coppell, TX 75019 (US). FACCIN, Stefano [IT/US]; 3421 Dartmoor

Drive, Dallas, TX 75229 (US). PURNADI, Rene [ID/US]; 118 Elm Fork Drive, Coppell, TX 75019 (US). KOODLI, Rajeev [IN/US]; 5 Kansas Street, No. 5, Natick, MA 01760 (US).

(74) Agents: BRUNDIDGE, Carl, I. et al.; Antonelli, Terry, Stout & Kraus, LLP, Suite 1800, 1300 N. Seventeenth Street, Arlington, VA 22209 (US).

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(54) Title: A SCHEME TO RELOCATE H.323 GATEKEEPER DURING A CALL WHEN ENDPOINT CHANGES ITS ZONE
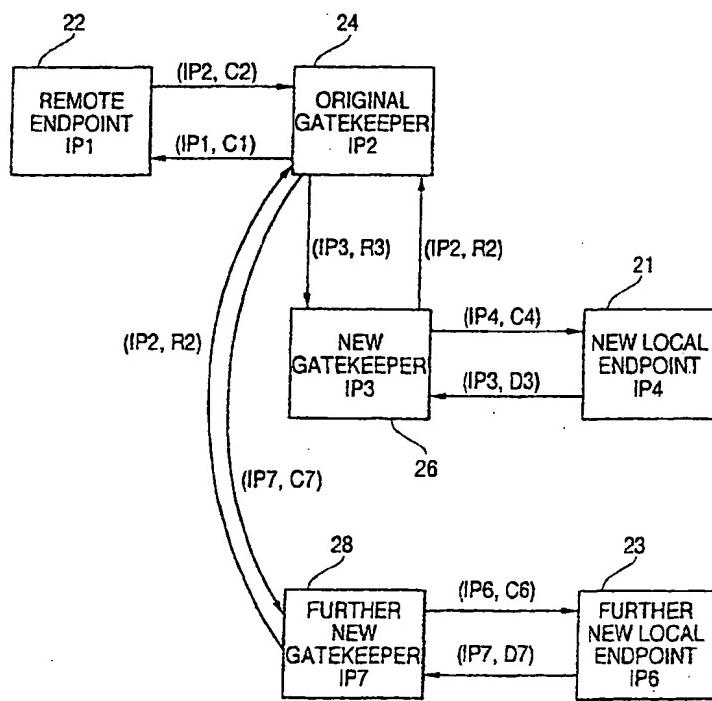
(57) Abstract: A method, computer program, and apparatus for allowing endpoints to move between zones of a packet-switched network. In the invention, a communication between local and remote endpoints are established via a first gatekeeper, which services a first zone of the packet-switched network, when the local endpoint is at a location serviced by the first zone of the packet-switched network. When the local endpoint moves to a location serviced by a second zone of the packet-switched network, subsequent to the initial hand-off, communication between the local and remote endpoints is maintained via the first gatekeeper and a second gatekeeper which services the second zone of the packet-switched network, by performing an initial hand-off communication control functions from the first gatekeeper to the second gatekeeper. When the local endpoint further moves to a location serviced by a third zone of the packet-switched network, communication between the local and remote endpoints is maintained via the first gatekeeper and a third gatekeeper, which services the third zone of the packet-switched network, by performing a subsequent hand-off of communication control functions from the second gatekeeper to the third gatekeeper.

A SCHEME TO RELOCATE H.323 GATEKEEPER DURING A CALL WHEN ENDPOINT CHANGES ITS ZONE

TECHNICAL FIELD

5   The present invention relates to packet-switched networks, such as Internet Protocol (IP) networks. More particularly, the present invention relates to a method, computer program and apparatus for allowing hand-off of an endpoint in a packet-switched network by allowing the

10   relocation of a gatekeeper during a call when the endpoint moves to a different zone of the packet-switched network.

Voice or telephony services can now be provided over a packet-switched network, such as the Internet. These packet-switched networks are commonly referred to as IP networks, IP

15   telephony networks or Voice over IP (VoIP) networks because the Internet protocol according to various IP based standards is the primary protocol used. One such IP based standard, for example, is the International Telecommunication Union (ITU) H.323 Standard.

20   The H.323 Standard provides a foundation for audio, video, and data communications across IP networks. By complying with the H.323 Standard, multimedia products and applications from multiple vendors can interoperate, allowing users to communicate without concern for compatibility. The

25   H.323 Standard is part of a larger series of communications standards that enable audio video conferencing across a range of networks.

The H.323 standard defines four major components for a network based communications, namely terminals, gateways,

30   gatekeepers and Multipoint Control Units (MCU).

Terminals are the client endpoints on the network that provide realtime two-way communications. All terminals which comply with the H.323 standard must also support the ITU H.245 standard, which is used to negotiate channel usage and

35   capabilities. Further, terminals which comply with the H.323 standard are required to implement the ITU Q.931 and the H.225 standards for call signaling and call setup, including for

Registration/Admission/Status (RAS) processing. Optional capabilities in terminals which comply with the H.323 standard are MCU capabilities.

The gateway is an optional element when implementing the H.323 standard. Each gateway provides many services the most common being a translation function between the H.323 standard conferencing endpoints and other terminal types. For example, this function could include translation between transmission formats and between communication procedures.

Gatekeepers are the most important component of an H.323 standard enabled network. It acts as a central point for all calls or communication within a zone serviced by the gatekeeper and provides call communication control services to registered endpoints. The gatekeeper could be considered a virtual switch. The gatekeeper performs four important call or communication control functions. The first is address translation from, for example, aliases for terminals and gateways to transport addresses. The second is admission control where the gatekeeper authorizes network access based on call authorization, bandwidth, or some other criteria. The third is bandwidth control which provides bandwidth management wherein the gatekeeper if necessary can refuse to make connections. The fourth is zone management where the gatekeeper provides each of the above noted functions for the terminals, MCU's and gateways that have been registered in the zone serviced by the gatekeeper.

The MCU supports conferences between three or more endpoints. Under the H.323 standard an MCU includes a multipoint controller which handles H.245 standard negotiations between all terminals to determine common capabilities for audio and video processing, and possibly a multipoint processor which mixes, switches and processes audio, video and/or data bits.

Each of the above described endpoints, gateway, gatekeeper, and MCU can be implemented by use of apparatus such as a personal computer (PC), workstation, server, etc.

The above described H.323 standard as defined is intended

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to operate in fixed packet-switched networks where the
endpoints, for example, terminals such as workstations, PC's,
etc., that conform to the H.323 standard, do not move to a new
zone serviced by another gatekeeper. As illustrated in Fig.

5   1, a packet-switched network which implements the H.323
standard can, for example, be organized into a plurality of
zones 100a-n. Each zone 100, for example, could include a
plurality of terminals 10a-n, a gatekeeper 12, at least one
gateway 14, at least one router 16 and at least one MCU 18.

10   Each of the routers 16a-n included in the packet-switched
network interconnects, for example, sub- networks included in
a zone 100 to each other, or interconnects, for example, zones
of the packet-switched network included in different zones of
the packet-switched network 100a-n to each other.

15   The packet-switched network illustrated in Fig. 1
implementing current IP standards, including the H.323
standard does not allow for the roaming or mobility of the
endpoint during a call or communication. Thus, for example,
the terminals 10a-e cannot roam or be mobile among the zones

20   100a-n in the packet-switched network while a call or
communication is being conducted. For example, such roaming or
mobility is important if, for example, the endpoint (terminal)
is implemented by a mobile telephone, laptop, Personal
Communications Services (PCS) device, etc., which comply with

25   the H.323 standard.
            Therefore, there exists a need for a technique that
allows endpoints implementing the H.323 standard to be able to
roam or have mobility between different zones, networks or
sub-networks of a packet-switched network.

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DISCLOSURE OF THE INVENTION

            The present invention provides a method, computer program
and apparatus for allowing hand-off of an endpoint in a
packet-switched network enabled by the H.323 standard by

35   allowing the relocation of a gatekeeper during a call when the
endpoint moves to a different section of the packet-switched
network.

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Particularly, the present invention provides a technique of allowing endpoints to move between different zones of a packet-switched network while maintaining communications already established with another endpoint. The present invention accomplishes this by establishing a communication between local and remote endpoints via a first gatekeeper, which services a first zone of the packet-switched network, when the local endpoint is at a location serviced by the first zone of the packet-switched network. The local endpoint is mobile and can be, for example, a device such as a wireless telephone, laptop computer, PCS device, etc. When the local endpoint moves to a location serviced by a second zone of the packet-switched network, the communication is maintained between the local and remote endpoints via the first and second gatekeepers. The second zone of the packet-switched network is serviced by the second gatekeeper.

The communication between the local and remote endpoints via the first and second gatekeepers is maintained by causing communication control functions previously performed by the first gatekeeper to be handed-off to the second gatekeeper. After such initial hand-off, the first gatekeeper relays communications between the remote endpoint and the second gatekeeper, and the second gatekeeper relays communications between the first gatekeeper and the local endpoint and performs communication control functions on communications between the local and remote endpoints. Thus, the present invention provides that when the local endpoint moves to a location serviced by a second gatekeeper, and after an initial hand-off the first gatekeeper performs primarily a relaying function and the second gatekeeper performs a relaying function and communication control functions between the local and remote endpoints.

The present invention also provides a technique for maintaining communication between the local and remote endpoints when the local endpoint moves, subsequent to the above described move, to a location serviced by a third zone of the packet-switched network. The third zone of the packet-

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switched network is serviced by a third gatekeeper.
Communication between the local and remote endpoints is
maintained by causing communication control functions
previously performed by the second gatekeeper to be handed-off

5   to the third gatekeeper. After such subsequent hand-off, the
first gatekeeper relays communications between the remote
endpoint and the third gatekeeper, rather than the second
gatekeeper, and the third gatekeeper relays communications
between the first gatekeeper and the local endpoint and

10   performs communication control functions on communications
between the local and remote endpoints. Thus, the present
invention provides that when the local endpoint moves,
subsequent to the above describe move, to a location serviced
by a third gatekeeper, and after a subsequent hand-off, the

15   first gatekeeper performs primarily a relaying function and
the third gatekeeper performs a relaying function and
communication control functions between the local and remote
endpoints.

       In the present invention, the above described technique

20   for maintaining communication between the local and remote
endpoint when the local endpoint moves, subsequent to an
initial move, to a location serviced by a third zone of the
packet-switched network can be applied to any further
subsequent moves of the local endpoint to a location serviced

25   by a further zone of the packet-switched network. The further
zone of the packet-switched network is serviced by a further
gatekeeper. Communication between the local and remote
endpoints is maintained by causing the communication control
functions previously performed by the third gatekeeper to be

30   hand-off to the further gatekeeper. After such further
subsequent hand-off, the first gatekeeper relays
communications between the remote endpoint and the further
gatekeeper, rather than the third gatekeeper. The further
gatekeeper relays communications between the first gatekeeper

35   and the local endpoint and performs communication control
functions on communications between the local and remote
endpoints.

BRIEF DESCRIPTION OF THE DRAWINGS

The scope of the present invention will be apparent from the following detailed description, when taken in conjunction with the accompanying drawings, and such detailed description and specific examples, while indicating preferred embodiments of the invention, are given by way of illustration only, since various changes and modifications within the spirit and scope of the invention will become apparent to those skilled in the art from this detailed description, in which:

Fig. 1 is a schematic diagram illustrating a conventional packet-switched network having a plurality of zones;

Fig. 2 is a schematic diagram illustrating a technique for allowing mobility of an endpoint in a packet-switched network after an initial hand-off according to the present invention;

Fig. 3 is a diagram illustrating procedures performed to accomplish the initial hand-off according to the present invention;

Fig. 4 is a schematic diagram illustrating a technique for allowing mobility, particularly hand-off, of an endpoint in a packet-switched network after a subsequent hand-off subsequent to an initial hand-off according to present invention; and

Fig. 5 is a diagram illustrating procedures performed to accomplish the subsequent hand-off according to the present invention.

BEST MODE FOR CARRYING OUT THE INVENTION

The present invention provides a method, computer program and apparatus for allowing hand-off mobility, particularly hand-off, of an endpoint in a packet-switched network by allowing the relocation of a gatekeeper during a call when the endpoint moves to a different zone of the packet-switched network.

The present invention provides for the establishment of a communication between local and remote endpoints via a first gatekeeper, which services a first zone of a packet-switched

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network, when the local endpoint is at a location serviced by
the first zone of the packet-switched network. As per the
H.323 standard the first gatekeeper performs communication
control functions according to the H.245 standard on
5   communications between the local and remote endpoints, when
the local endpoint is at a location serviced by the first zone
of the packet-switched network, and when communication has
been established between the local and remote endpoints. The
local endpoint is mobile and can be, for example, a device
10   such as a wireless telephone, laptop computer, PCS device,
etc.

When the local endpoint moves to a location serviced by a
second zone of the packet-switched network, the present
invention causes the communication control functions,
15   previously performed by the first gatekeeper, to be initially
hand-off to a second gatekeeper which services the second zone
of the packet-switched network. After such initial hand-off,
communication between the local and remote endpoints is
maintained by causing the first gatekeeper to relay
20   communications between the remote endpoint and the second
gatekeeper, and causing the second gatekeeper to relay
communications between the first gatekeeper and the local
endpoint and perform communication control functions on
communications between the local and remote endpoints.

25   When the local endpoint moves, subsequent to the above
described move to a second zone serviced by the second
gatekeeper, to a location serviced by a third zone of the
packet-switched network, the present invention causes the
communication control functions, previously performed by the
30   second gatekeeper, to be subsequently hand-off to a third
gatekeeper. The third gatekeeper services the third zone of
the packet-switched network. After such subsequent hand-off,
communications between the local and remote endpoint is
maintained by causing the first gatekeeper to relay
35   communications between the remote endpoint and the third
gatekeeper, excluding the second gatekeeper, and causing the
third gatekeeper to relay communications between the first

gatekeeper and the local endpoint and perform communication
control functions on communications between the local and
remote endpoints.

5   The present invention is intended to operate in a packet-
switched network which can, for example, include IP telephony
networks or VoIP networks which implement the H.323 standard.
The H.323 standard as currently defined is for fixed networks
where, for example, endpoints are not allowed to move. Thus,
allowing for the mobility, particularly hand-off, of endpoints
10   among the zones of the packet-switched network has not been
provided in the current H.323 standard. The present invention
satisfies this need by providing a technique that allows
endpoints, such as wireless telephones, laptop computers, PCS
devices, etc., implementing the H.323 standard, to have
15   mobility, particularly hand-off, between different zones, or
sub-networks of a packet-switched network.

The procedures performed by the present invention prior
to and after the initial hand-off will be described using the
illustration of the present invention in Fig. 2. The initial
20   hand-off will be described below using the illustration of the
present invention in Fig. 3.

As illustrated in Fig. 2, the present invention provides
an old local endpoint 20 having an IP address IP5, a remote
endpoint 22 having an IP address IP1, and an original
25   gatekeeper 24 having an IP address IP2. The local endpoint 20
is mobile and can be, for example, a device such as a wireless
telephone, laptop computer, PCS device, etc. Prior to the
initial hand-off, and when communications between the local
endpoint 20 and the remote endpoint 22 has been established,
30   the original gatekeeper 24 operates in the normal manner
according to the H.323 standard. Namely, the original   ꞁ fns of
gatekeeper 24 performs communication control functions   ｝ gatekeepo.
according to the H.245 standard on communications between the ｝
old local endpoint 20 and the remote endpoint 22.

35   It should be noted with respect to each of Figs. 2-5, IPX
corresponds to an IP address and DX, CX, RX, correspond to TCP
or UDP port numbers. Further, it should be noted that the IP

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addresses of each of the elements illustrated in Figs. 2-5
particularly the old local endpoint 20 and the new local
endpoint 21 can be different.

When the original gatekeeper 24 is operated normally and

5   a communication has been established between the old local
endpoint 20 and the remote endpoint 22, the remote endpoint 22
can send a message to the old local endpoint 20 via the
original gatekeeper 24 at IP2, C2. The original gatekeeper 24
controls communications, namely the call between the remote

10   endpoint 22 and the local endpoint 20, using the H.245
standard. Thus, in response to the message at IP2, C2 from the
remote endpoint 22, the original gatekeeper 24 transmits a
message according to the H.245 standard to the old local
endpoint 20 at IP5, C5. The old local endpoint 20 can also

15   send a message to the remote endpoint 22 via the original
gatekeeper 24 at IP2, D2. The original gatekeeper 24, in
response to the message from the old endpoint 20 at IP2, D2,
and according to the H.245 standard, transmits a message to
the remote endpoint 22 at IP1, C1.

20   Thus, when the gatekeeper 24 operates normally
communications can be established between the old local
endpoint 20 and the remote endpoint 22. Such is provided for
in the H.323 standard. The control of communications is
accomplish according to the H.245 standard.

25   However, when the old local endpoint 20 moves to a new
location, which is illustrated in Fig. 2 by the new local
endpoint 21, and after the initial hand-off has been
conducted, the original gatekeeper 24 operates differently
according to the present invention. Particularly, the

30   original gatekeeper 24 now performs a relay function and the
communication control functions previously performed by the
original gatekeeper 24 are initially hand-off to a new
gatekeeper 26. The new gatekeeper 26 services the zone of the
packet-switched network at which the new local endpoint 21 is

35   now positioned. The initial hand-off of the communication
control functions from the original gatekeeper 24 to the new
gatekeeper 26 may include various operations such as, for

example, procedures for changing radio channels, registering new IP addresses, changing routing tables, etc. These procedures will be described below with respect to Fig. 3.

After the initial hand-off is performed, as per the
5 above, the original gatekeeper 24 performs a relay function so as to relay all messages between the remote endpoint 22 and the new local endpoint 21 via the new gatekeeper 26. Specifically, the original gatekeeper 24 relays messages between the remote endpoint 22 and the new gatekeeper 26.
10 Thus, as illustrated in Fig. 2, a message sent from the remote endpoint 22 at IP2, C2 is relayed by the original gatekeeper 24 to the new gatekeeper at IP3, R3. Further, as illustrated in Fig. 2, a message sent from the new gatekeeper 26 at IP2, R2 is relayed by the original gatekeeper 24 to the remote
15 endpoint 22 at IP1, C1.

The new gatekeeper 26 also performs a relay function so as to relay all messages between the new local endpoint 21 and the remote endpoint 22 via the original gatekeeper 24. Specifically, the new gatekeeper 26 relays messages between
20 the new local endpoint 21 and the original gatekeeper 24. Thus, as illustrated in Fig. 2, a message sent from the new local endpoint at IP3, C3 is relayed by the new gatekeeper 26 to the original gatekeeper at IP2, R2. Further, as illustrated in Fig. 2, a message sent from the original
25 gatekeeper 24 at IP3, R3 is relayed by the new gatekeeper 26 to the new local endpoint 21 at IP4, C4.

According to the present invention, in addition to performing the above described relay function the new gatekeeper 26 operates in a manner similar to the operations
30 previously performed by the original gatekeeper 24 before the initial hand-off. Particularly, for example, the new gatekeeper 26 performs communication control functions according to the H.245 standard on communications between the local and remote endpoints previously performed by the
35 original gatekeeper 24.

The details of the procedures performed by the present invention to effect the initial hand-off are illustrated in

Fig. 3. As shown in Fig. 3 various hand-off related
procedures are performed when the old local endpoint 20 moves
to the new local endpoint 21 location. These hand-off related
procedures could, for example, include procedures for changing
5   radio channels, etc.
          After the hand-off related procedures are performed, the
old local endpoint 20 transmits an un-register request (URQ)
to the original gatekeeper 24 requesting that the registration
of the old local endpoint 20 be removed. The URQ message can,
10   for example, be a special URQ message which causes the removal
of registration of the mobile local endpoint without
completely destroying the protocol stack which is used for
performing relaying functions. If a special URQ message is
used to effect the above described function, then a non-
15   special URQ message causes the removal of registration of the
mobile endpoint and a complete destroying of the protocol
stack. The original gatekeeper 24, in response to the special
URQ message, performs a step A which, for example, includes
removing registration of the old local endpoint 20 by
20   modifying the protocol stack without completely destroying it.
The remaining information is used to effect the relaying
function. Also the original gatekeeper 24, in response to the
special URQ message, disables its communication control
functions as described below.
25   The new local endpoint 21, when located at another zone
of the packet-switched network serviced by the new gatekeeper
26, sends a register request (RRQ) message to the new
gatekeeper 26. The RRQ message, can, for example, be a special
RRQ message which causes the registration of the local
30   endpoint as a mobile local endpoint previously located in
another zone of the packet-switched network serviced by
another gatekeeper. If a special RRQ message is used to effect
the above described function, then a non-special RRQ message
causes the registration of an endpoint to be located in the
35   zone of the packet-switched network and serviced by the
gatekeeper servicing the zone of the packet-switched network.
          By using the gatekeeper discovery scheme, the new

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gatekeeper 26 discovers the address information, for example, IP address and port number of the original gatekeeper 24. The new gatekeeper 26 sends a gatekeeper (GK) status request message, formed using call identification (ID) information of

5   the call between the local and remote endpoints, to the original gatekeeper 24. The original gatekeeper 24, in response to the GK status request message sends a gatekeeper (GK) status request acknowledgment (ACK) message, which includes GK state information according to the H.323 standard

10   having, for example, user plane information (U state information), relay gatekeeper IP address, TCP port number, etc., to the new gatekeeper 26. The user plane information indicates the plane upon which the call between the local and remote endpoints is being conducted, the relay gatekeeper IP

15   address indicates the IP address of the original gatekeeper 24 since it will serve primarily a relay function, and the TCP port number indicates the port number at the original gatekeeper 24 which received messages from the old local endpoint 20.

20   The new gatekeeper 26 in response to the GK status request ACK message transmits a relay setup message indicating a relay TCP port number to the original gatekeeper 24. Based on such information the original gatekeeper 24 performs a step B which, for example, includes creating a new routing table to

25   accomplish the relay function and deactivating its communication control functions.

         Thereafter, the original gatekeeper 24 sends a relay setup ACK message to the new gatekeeper 26 and sends an un-register confirmation (UCF) message to the old local endpoint

30   20. The UCF message can, for example, be a special UCF message which confirms the removal of the registration of the old local endpoint 20 from the original gatekeeper 24 which services the zone of the packet-switched network to which the old local endpoint 20 was connected. Particularly, the

35   special UCF message recognizes that the registration for the old local endpoint 20 was a registration of a mobile local endpoint. If a special UCF message is used to effect the above

●   ●

described function, then a non-special UCF message confirms
the removal of registration of the mobile local endpoint. The
new gatekeeper 26 sends a register confirmation (RCF) message
to the new local endpoint 21. The RCF message can, for

5   example, be a special RCF message which confirms the
registration of the new local endpoint 21 in the new
gatekeeper 26 which services the zone of the packet-switched
network to which the new local endpoint 21 is now connected.
Particularly, the special RCF message confirms the

10   registration of a mobile local endpoint. If a special RCF
message is used to effect the above described function, then a
non-special RCF message confirms the registration of a mobile
local endpoint. The new gatekeeper 26 then performs a step C
which, for example, includes creating a routing table for

15   accomplishing the relay function, and executing Q.931
procedures to setup new channels implemented according to the
H.225 and H.245 standards between the remote endpoint 22 and
the new local endpoint 21, via the new gatekeeper 26. Step C
performed by the new gatekeeper 26, could also include

20   associating GK state information with the new H.245 standard
implemented channels, and copying the U state information into
a new H.245 standard implemented control entity.

As a result of the above described initial hand-off
procedures illustrated in Fig. 3, communications are

25   maintained between the new local endpoint 21 and remote
endpoint 22 through the original gatekeeper 24 and the new
gatekeeper 26 such that the original gatekeeper 24 performs a
relay function and the new gatekeeper 26 performs the
communication control functions.

30   The present invention also provides a technique where
communications between the remote and local endpoints are
maintained even if the new local endpoint 21 moves to a
subsequent or new location at a further new local endpoint 23,
within another zone of the packet-switched network serviced by

35   a further new gatekeeper 28. Such is illustrated in Fig. 4.
Procedures performed by the present invention prior to and
after the subsequent hand-off, which occurs after the initial

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hand-off, will be described using the illustration of the
present invention in Fig. 4. The procedures performed by the
present invention to effect the subsequent hand-off will be
described using the illustration of the present invention in
5   Fig. 5.

Fig. 4, is similar to Fig. 2 with the exception of the
further new local endpoint 23 having an IP address IP6, and
the further new gatekeeper 28 having an IP address IP7.

As illustrated in Fig. 4, prior to the subsequent hand-
10   off, the original gatekeeper 24 and the new gatekeeper 26
perform the same functions such as that described above and
illustrated in Fig. 2 after the initial hand-off. Namely, the
original gatekeeper 24 performs a relay function between the
remote endpoint 22 and the new gatekeeper 26, and the new
15   gatekeeper 26 performs a relay function between the original
gatekeeper 24 and the new local endpoint 21 and performs
communication control functions between the new local endpoint
21 and the remote endpoint 22. However, when the new local
endpoint 21 moves to a further new location illustrated by the
20   further new endpoint 23 in Fig. 4, the subsequent hand-off
procedures are performed to hand-off the communication control
functions, previously performed by the new gatekeeper 26, to
the further new gatekeeper 28. As a result of the subsequent
hand-off the communication established between the remote and
25   local endpoints is maintained via the original gatekeeper 24
and the further new gatekeeper 28.

After, the subsequent hand-off is performed, the original
gatekeeper 24 and the further new gatekeeper 28 operate as
follows. Namely, the original gatekeeper 24 performs a relay
30   function so as to relay all messages between the remote
endpoint 22 and the further new local endpoint 23 via the
further new gatekeeper 28, excluding the new gatekeeper 26.
Specifically, the original gatekeeper 24 relays messages
between the remote endpoint 22 and the further new gatekeeper
35   28, excluding the new gatekeeper 26. Thus, as illustrated in
Fig. 4, a message sent from the remote endpoint 22 at IP2, C2,
is relayed by the original gatekeeper 24 to the further new

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gatekeeper 28 at IP7, C7. Further, as illustrated in Fig. 4, a message sent from the further new gatekeeper 28 at IP2, R2 is relayed by original gatekeeper 24 to the remote endpoint 22 at IP1, C1.

5   The further new gatekeeper 28 also performs a relay function so as to relay all messages between the further new local endpoint 23 and the remote endpoint 22 via the original gatekeeper 24. Specifically, the further new gatekeeper 28 relays messages between the original gatekeeper 24 and the

10   further new local endpoint 23. Thus, as illustrated in Fig. 4, a message sent from the further new local endpoint at IP7, D7 is relayed by the further new gatekeeper 28 to the original gatekeeper 24 at IP2, R2. Further, as illustrated in Fig. 4, a message sent from the original gatekeeper 24 at IP7, C7 is

15   relayed by the further new gatekeeper 28 to the further new local endpoint 23 at IP6, C6.

According to the present invention, in addition to performing the above described relay function the further new gatekeeper 28 operates in a manner similar to the operations

20   previously performed by the new gatekeeper 26 after the initial hand-off but prior to the subsequent hand-off. Particularly, for example, the further new gatekeeper 28 performs communication control functions according to the H.245 standard on communications between the local and remote

25   endpoints previously performed by the new gatekeeper 26.

The details of the procedures performed by the present invention to effect the subsequent hand-off are illustrated in Fig. 5. The subsequent hand-off procedures illustrated in Fig. 5 are similar to the initial hand-off procedures illustrated

30   in Fig. 3. The primary difference being that in the subsequent hand-off, the communication control functions previously performed by the new gatekeeper 26 are hand-off to the further new gatekeeper 28, whereas in the initial hand-off, the communication control functions previously performed by the

35   original gatekeeper 24 are hand-off to the new gatekeeper 26.

The details of the subsequent hand-off procedures are as follows. As illustrated in Fig. 5 after the hand-off related

procedures are performed, the new local endpoint 21 sends a special URQ message to the new gatekeeper 26. The new gatekeeper 26, in response to the special URQ message, performs step A as described above including, for example,

5   removing registration of the new local endpoint 21 by modifying the protocol stack without completely destroying it. The remaining information will be used to effect the relaying function. The new gatekeeper 26 also disables its communication control functions in response to the special URQ

10   message as described below.

Next the further new endpoint 23, when located at another zone of the packet-switched network serviced by the further new gatekeeper 28, sends a special RRQ message to the further new gatekeeper 28 requesting that the further new local

15   endpoint 23 be registered. The further new gatekeeper 28 then sends a GK status request message using the call ID information of the call between local and remote endpoints to the new gatekeeper 26. The new gatekeeper 26, in response to the GK status request message, sends a GK status request ACK

20   message which includes GK state information according to the H.323 standard having, for example, user plane information, relay gatekeeper IP address, TCP port number, etc., to the further new gatekeeper 28. The further new gatekeeper 28 upon receipt of the GK status request ACK message stores such

25   information and then sends a relay setup message including the relay TCP port number to the original gatekeeper 24.

The new gatekeeper 26 after sending the GK status request ACK message performs a step B which, for example, includes deactivating its relay and communication control functions.

30   Thus, the new gatekeeper 26 is dismissed from the call between the remote and local endpoints. When the new gatekeeper 26 is dismissed, the protocol stack is not completely destroyed. The new gatekeeper 26 then sends a special UCF message to the new local endpoint 21 using the remaining information of the

35   protocol stack.

Thereafter, the further new gatekeeper 28, in response to relay setup ACK message from the original gatekeeper 24, sends

a special RCF message to the further new local endpoint 23 and
performs step C as described above including, for example,
creating a new routing table for conducting the relaying
operation, executing Q.931 standard procedures to setup new

5   channels implemented according to the H.245 standard between
remote endpoint 22 and the further new local endpoint 23 via
the further new gatekeeper 28, associating the GK status
information with the new H.245 implemented channels, and
copying the U state information into the new H.245 standard

10   implemented control entity

       As a result of the above described subsequent hand-off
procedures illustrated in Fig. 5, communications are
maintained between the remote endpoint 22 and the further new
local endpoint 23 through the original gatekeeper 24 and the

15   further new gatekeeper 28 such that the original gatekeeper 24
performs a relay function and the further new gatekeeper 28
performs the communication control functions.

       The technique of the present invention, particularly that
illustrated in Figs. 4 and 5 allows for communications to be

20   maintained between the remote and local endpoints even when
the further new local endpoint 23 moves to a further
subsequent or further new location. In order to maintain such
communications, the present invention implements procedures
such as that illustrated in Fig. 5, wherein the further new

25   gatekeeper 28 performs functions same as the new gatekeeper
26. Specifically, the relaying and communication control
functions of the further new gatekeeper 28 are deactivated and
the further new gatekeeper 28 is dismissed from the call
between the remote and local endpoints. Thereafter, an even

30   further new gatekeeper (not shown) registers the even further
new local endpoint (not shown), performs a relaying function
between the original gatekeeper and the even further new local
endpoint, and performs communication control functions between
the remote endpoint and the even further new local endpoint.

35   The hand-off procedures to effect this operation is, for
example, such as that illustrated in Fig. 5 wherein the new
gatekeeper 26 is now the further new gatekeeper 28 and the

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further new gatekeeper 28 is now the even further new
gatekeeper. Also the new local endpoint 21 is now the further
new local endpoint 23, and the further new local endpoint 23
is replaced by an even further new local endpoint.

5   According to the above described features, the present
invention provides an apparatus, wherein a mobile local
endpoint can freely move throughout a packet-switched network
and still maintain communications with a remote endpoint even
if the mobile local endpoint successively moves to
10   successively different zones of the packet-switched network.
       Therefore, according to the present invention as
described above, a technique is provided for allowing
endpoints to move between zones of a packet-switched network.
The technique allows for a communication to be established
15   between local and remote endpoints via a first gatekeeper
which services a first zone of the packet-switched network,
when the local endpoint is at a location serviced by the first
zone of the packet-switched network. The local endpoint is
mobile and can be, for example, a device such as a wireless
20   telephone, laptop computer, PCS device, etc. The technique
also allows communication between the local and remote
endpoints to be maintained via the first gatekeeper and a
second gatekeeper, which services a second zone of the packet-
switched network, when the local endpoint moves to a location
25   serviced by the second zone of the packet-switched network.
The technique of the present invention further allows
communication between the local and remote endpoints to be
maintained when the local endpoint further moves to a location
serviced by a third zone of the packet-switched network,
30   wherein the third zone of the packet-switched network is
serviced by a third gatekeeper.
       The above described technique of the present invention
can be implemented, for example, by a computer program
operating in each gatekeeper implemented according to the
35   H.323 standard or by apparatus provided in each gatekeeper.
The computer program implementing the technique of the present
invention could, for example, include code or sections of code

●   ●

that when executed causes a computer or other similar
apparatus to perform steps such as that illustrated in Figs.
2-5. The apparatus implementing the technique of the present
invention could, for example, include various elements which
5   implement the functions and procedures illustrated in Figs. 2-
5.

       The computer program could, for example, be stored on a
storage medium such as floppy disk, CD Rom, memory device,
etc., and installed on apparatus used to implement the
10   functions of a gatekeeper. The computer program could also be
stored in the ROM of the apparatus implementing the functions
of a gatekeeper. Further, the computer program could, for
example, be provided to the apparatus implementing the
functions of a gatekeeper by a network such as a LAN or
15   Internet connected to the apparatus.

       Therefore, according to the description above, the
present invention when set forth in a packet-switched network
implemented according to the H.323 standard, allows for
mobility, particularly hand-off, of an endpoint in the packet-
20   switched network by allowing the relocation of a gatekeeper
during a call when the endpoint moves to a different zone of
the packet-switched network.

       While the present invention has been described in detail
and pictorially in the accompanying drawings, it is not
25   limited to such details since many changes and modification
recognizable to these of ordinary skill in the art having the
benefit of this invention may be made to the invention without
departing from the spirit and scope of the invention, and all
such modifications as would be obvious to one skilled in the
30   art and/or which become possible as technology develops, are
intended to be included within the scope of the following
claims.

WE CLAIM:

1.   A method of allowing endpoints to move between different zones of a packet-switched network, comprising the steps of:

establishing a communication between local and remote endpoints via a first gatekeeper, which services a first zone of the packet-switched network, when said local endpoint is at a location serviced by said first zone of the packet-switched network; and

maintaining communication between said local and remote endpoints via said first gatekeeper and a second gatekeeper, which services a second zone of the packet-switched network, when said local endpoint moves to a location serviced by said second zone of the packet-switched network.

2.   A method according to claim 1, wherein said maintaining step comprises the step of:

handing-off communication control functions from said first gatekeeper to said second gatekeeper, when said local endpoint moves to said second zone of said packet-switched network serviced by said second gatekeeper.

3.   A method according to claim 2, wherein said maintaining step further comprises the steps of:

relaying, by said first gatekeeper, communications between said remote endpoint and said second gatekeeper;

relaying, by said second gatekeeper, communications between said first gatekeeper and said local endpoint; and

performing, by said second gatekeeper, communication control functions, previously performed by said first gatekeeper, on communications between said local and remote endpoints.

4.   A method according to claim 1, wherein each endpoint implements the H.323 standard.

●   ●

5.   A method according to claim 2, wherein each endpoint implements the H.323 standard.

6.   A method according to claim 3, wherein each endpoint implements the H.323 standard.

7.   A method according to claim 1, wherein when said local endpoint is at the location serviced by said first zone of the packet-switched network, communication control functions between said local and remote endpoints are performed by said first gatekeeper, and
         wherein when said local endpoint moves to the location serviced by said second zone of the packet-switched network, communication control functions between said local and remote endpoints are performed by said second gatekeeper.

8.   A method according to claim 7, wherein said communication control functions are performed according to the H.245 standard.

9.   A method according to claim 2, wherein said communication control functions are performed according to the H.245 standard.

10.   A method according to claim 3, wherein said communication control functions are performed according to the H.245 standard.

11.   A method according to claim 1, further comprising the step of:
         further maintaining communication between said local and remote endpoints via said first gatekeeper and a third gatekeeper, which services a third zone of the packet-switched network, when said local endpoint moves to a location serviced by said third zone of the packet-switched network.

12.   A method according to claim 11, wherein said further

21

maintaining step comprises the step of:

handing-off communication control functions from said second gatekeeper to said third gatekeeper, when said local endpoint moves to said third zone of said packet-switched network serviced by said third gatekeeper.

13. A method according to claim 12, wherein said further maintaining step further comprises the steps of:

relaying, by said first gatekeeper, communications between said remote endpoint and said third gatekeeper;

relaying, by said third gatekeeper, communications between said first gatekeeper and said local endpoint; and

performing, by said third gatekeeper, communication control functions, previously performed by said second gatekeeper, on communications between said local and remote endpoints.

14. A method according to claim 11, wherein each endpoint implements the H.323 standard.

15. A method according to claim 12, wherein each endpoint implements the H.323 standard.

16. A method according to claim 13, wherein each endpoint implements the H.323 standard.

17. A method according to claim 11, wherein when said local endpoint is at the location serviced by said second zone of the packet-switched network, communication control functions between said local and remote endpoints are performed by said second gatekeeper, and

wherein when said local endpoint moves to the location serviced by said third zone of the packet-switched network, communication control functions between said local and remote endpoints are performed by said third gatekeeper.

18. A method according to claim 17, wherein said

communication control functions are performed according to the H.245 standard.

19. A method according to claim 12, wherein said communication control functions are performed according to the H.245 standard.

20. A method according to claim 13, wherein said communication control functions are performed according to the H.245 standard.

21. A computer program stored on a storage medium readable by a computer for allowing endpoints to move between different zones of a packet-switched network, said computer program when executed causes the computer to perform the steps of:

establishing a communication between local and remote endpoints via a first gatekeeper, which services a first zone of the packet-switched network, when said local endpoint is at a location serviced by said first zone of the packet-switched network; and

maintaining communication between said local and remote endpoints via said first gatekeeper and a second gatekeeper, which services a second zone of the packet-switched network, when said local endpoint moves to a location serviced by said second zone of the packet-switched network.

22. A computer program according to claim 21, wherein said maintaining step comprises the step of:

handing-off communication control functions from said first gatekeeper to said second gatekeeper, when said local endpoint moves to said second zone of said packet-switched network serviced by said second gatekeeper.

23. A computer program according to claim 22, wherein said maintaining step further comprises the steps of:

relaying, by said first gatekeeper, communications

between said remote endpoint and said second gatekeeper;
relaying, by said second gatekeeper, communications
between said first gatekeeper and said local endpoint; and
performing, by said second gatekeeper, communication
control functions, previously performed by said first
gatekeeper, on communications between said local and remote
endpoints.

24. A computer program according to claim 21, wherein
when said local endpoint is at the location serviced by said
first zone of the packet-switched network, communication
control functions between said local and remote endpoints are
performed by said first gatekeeper, and
wherein when said local endpoint moves to the
location serviced by said second zone of the packet-switched
network, communication control functions between said local
and remote endpoints are performed by said second gatekeeper.

25. A computer program according to claim 21, wherein
said computer program when executed further causes the
computer to perform the step of:
further maintaining communication between said local
and remote endpoints via said first gatekeeper and a third
gatekeeper, which services a third zone of the packet-switched
network, when said local endpoint moves to a location serviced
by said third zone of the packet-switched network.

26. A computer program according to claim 25, wherein
said further maintaining step comprises the step of:
handing-off communication control functions from
said second gatekeeper to said third gatekeeper, when said
local endpoint moves to said third zone of said packet-
switched network serviced by said third gatekeeper.

27. A computer program according to claim 26, wherein
said further maintaining step further comprises the steps of:
relaying, by said first gatekeeper, communications

between said remote endpoint and said third gatekeeper;

relaying, by said third gatekeeper, communications between said first gatekeeper and said local endpoint; and

performing, by said third gatekeeper, communication control functions, previously performed by said second gatekeeper, on communications between said local and remote endpoints.

28.   A computer program according to claim 25, wherein when said local endpoint is at the location serviced by said second zone of the packet-switched network, communication control functions between said local and remote endpoints are performed by said second gatekeeper, and

wherein when said local endpoint moves to the location serviced by said third zone of the packet-switched network, communication control functions between said local and remote endpoints are performed by said third gatekeeper.

29.   A gatekeeper for servicing a zone of a packet-switched network and allowing endpoints to move from said zone to another zone of said packet-switched network, said gatekeeper comprising:

means for establishing a communication between local and remote endpoints, when said local endpoint is at a location within said zone of the packet-switched network serviced by said gatekeeper; and

means for maintaining communication between said local and remote endpoints via said gatekeeper and another gatekeeper, which services another zone of the packet-switched network, when said local endpoint moves to a location within said another zone of the packet-switched network serviced by said another gatekeeper.

30.   A gatekeeper according to claim 29, wherein said maintaining means comprises:

means for handing-off communication control functions from said gatekeeper to said another gatekeeper,

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when said local endpoint moves to said another zone of said packet-switched network serviced by said another gatekeeper.

31.   A gatekeeper according to claim 30, wherein said maintaining means further comprises:

means for relaying communications between said remote endpoint and said another gatekeeper,

wherein said another gatekeeper, relays communications between said gatekeeper and said local endpoint, and performs communication control functions, previously performed by said gatekeeper, on communications between said local and remote endpoints.

32.   A gatekeeper according to claim 29, wherein said gatekeeper implements the H.323 standard.

INTERNATIONAL SEARCH REPORT

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7   H04L29/06   H04N7/15

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7   H04L   H04M   H04N

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, WPI Data, PAJ, INSPEC, COMPENDEX, IBM-TDB

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	LIAO W: "MOBILE INTERNET TELEPHONY: MOBILE EXTENSIONS TO H.323" PROCEEDINGS IEEE INFOCOM. THE CONFERENCE ON COMPUTER COMMUNICATIONS,US,NEW YORK, NY: IEEE, 21 March 1999 (1999-03-21), pages 12-19, XP000868780 ISBN: 0-7803-5418-4	1,2,4,5, 7-9,11, 12,14, 15, 17-19, 21,22, 24-26, 28-30,32
Y		3,6,10, 13,16, 20,23, 27,31
	page 14, column 2.2; figure 2 page 26	

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[X]	Further documents are listed in the continuation of box C.	[X]	Patent family members are listed in annex.

° Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

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"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
12 December 2000	19/12/2000

| Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31–70) 340-2040, Tx. 31 651 epo nl, Fax: (+31–70) 340-3016	Stergiou, C

FIG. 5
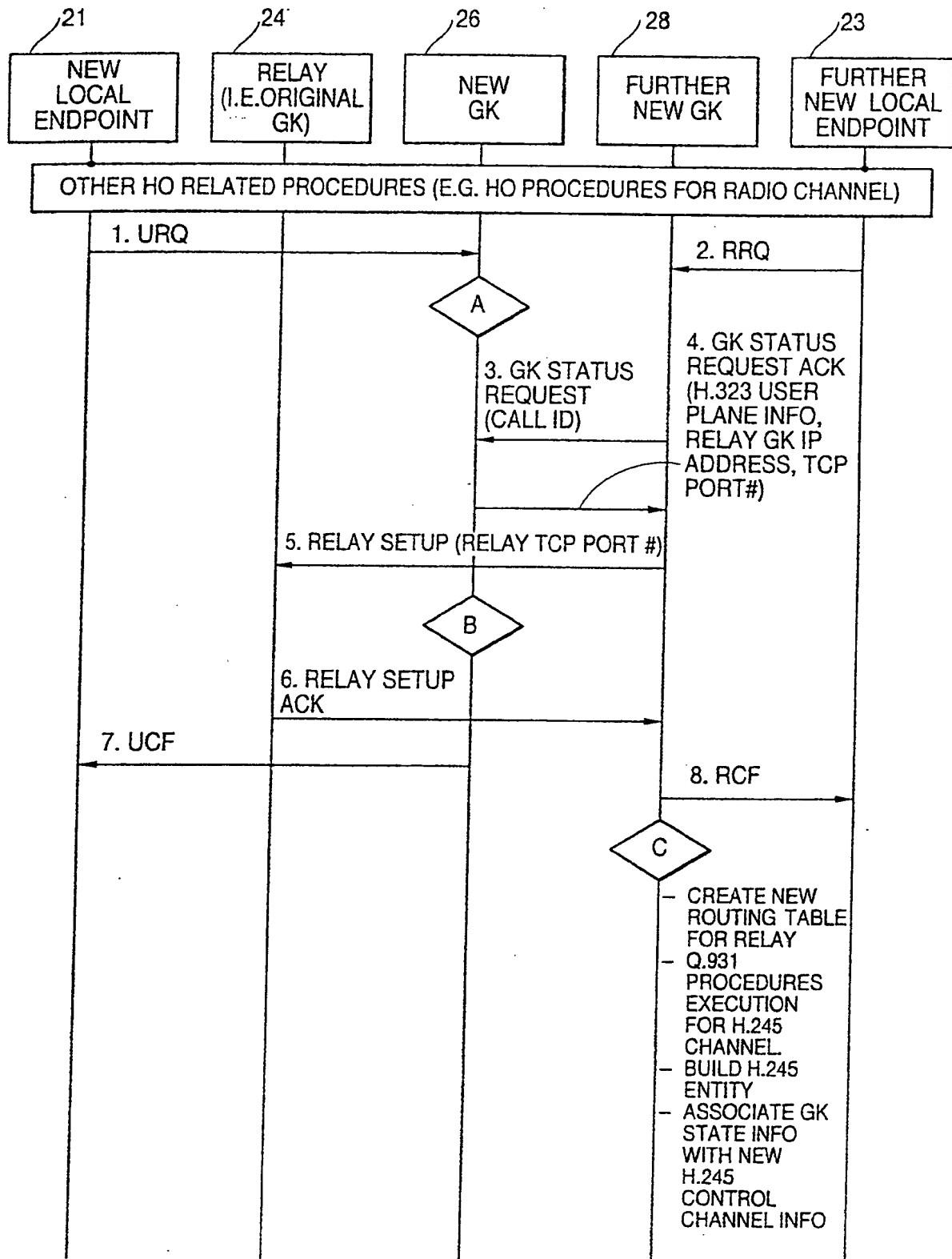
FIG. 4
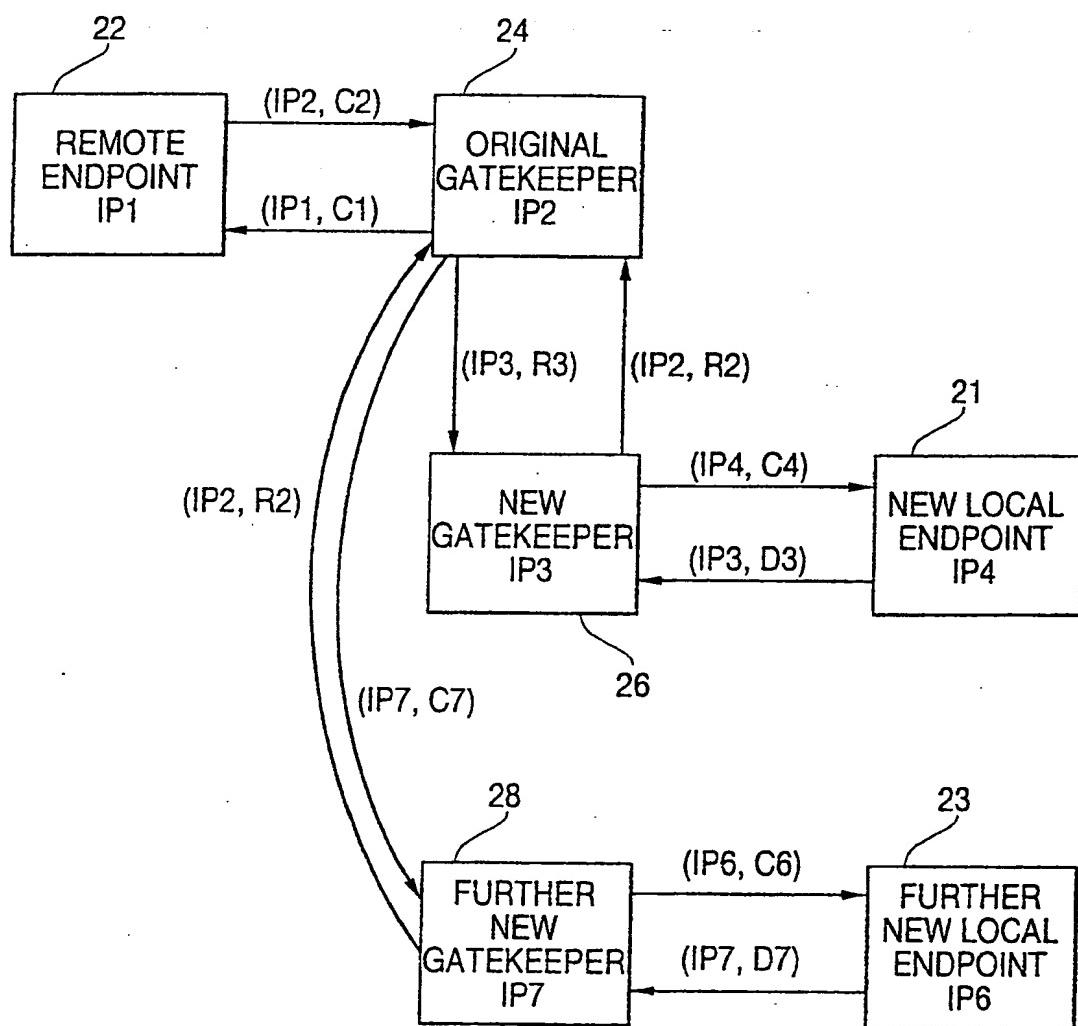
FIG. 3
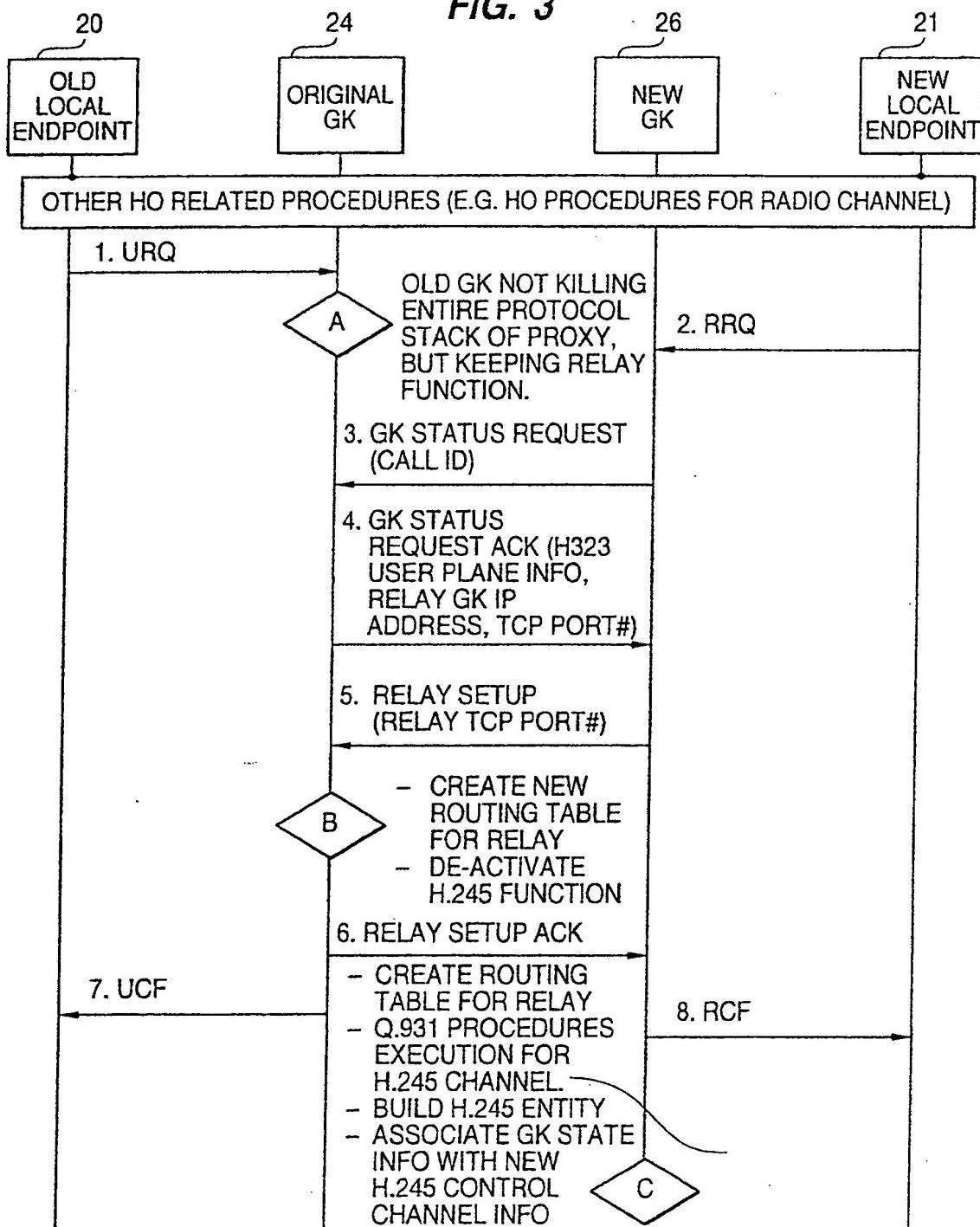
FIG. 2
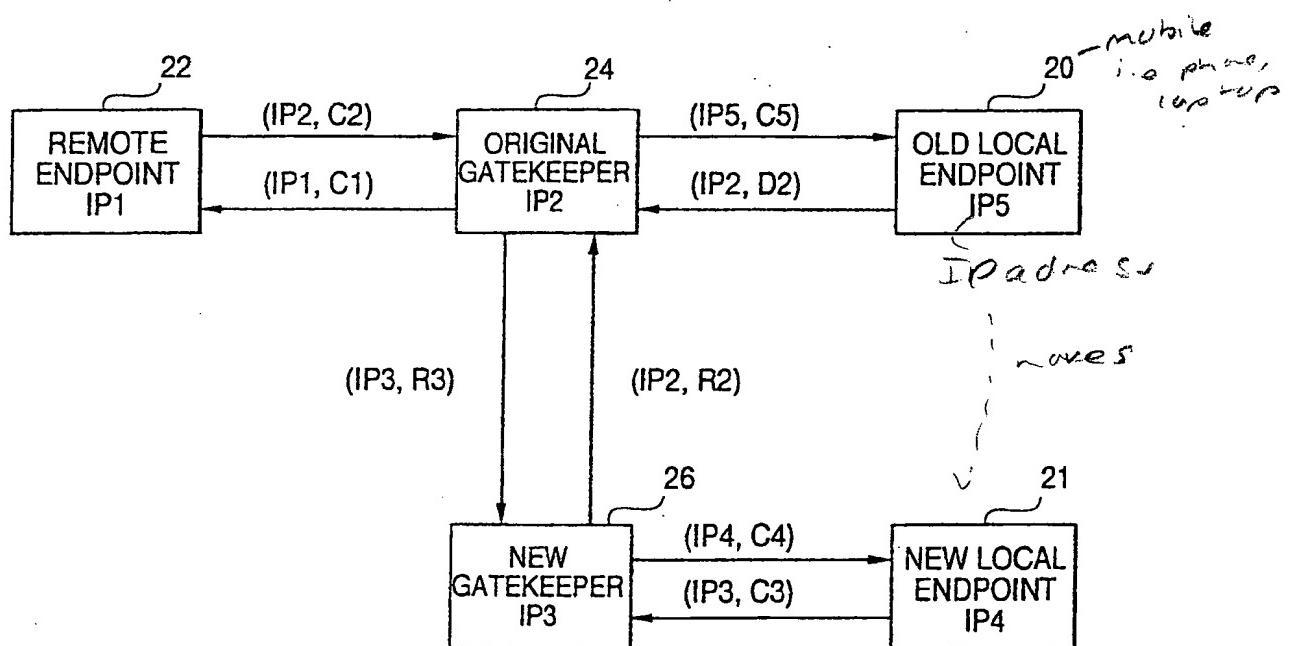
FIG. 1
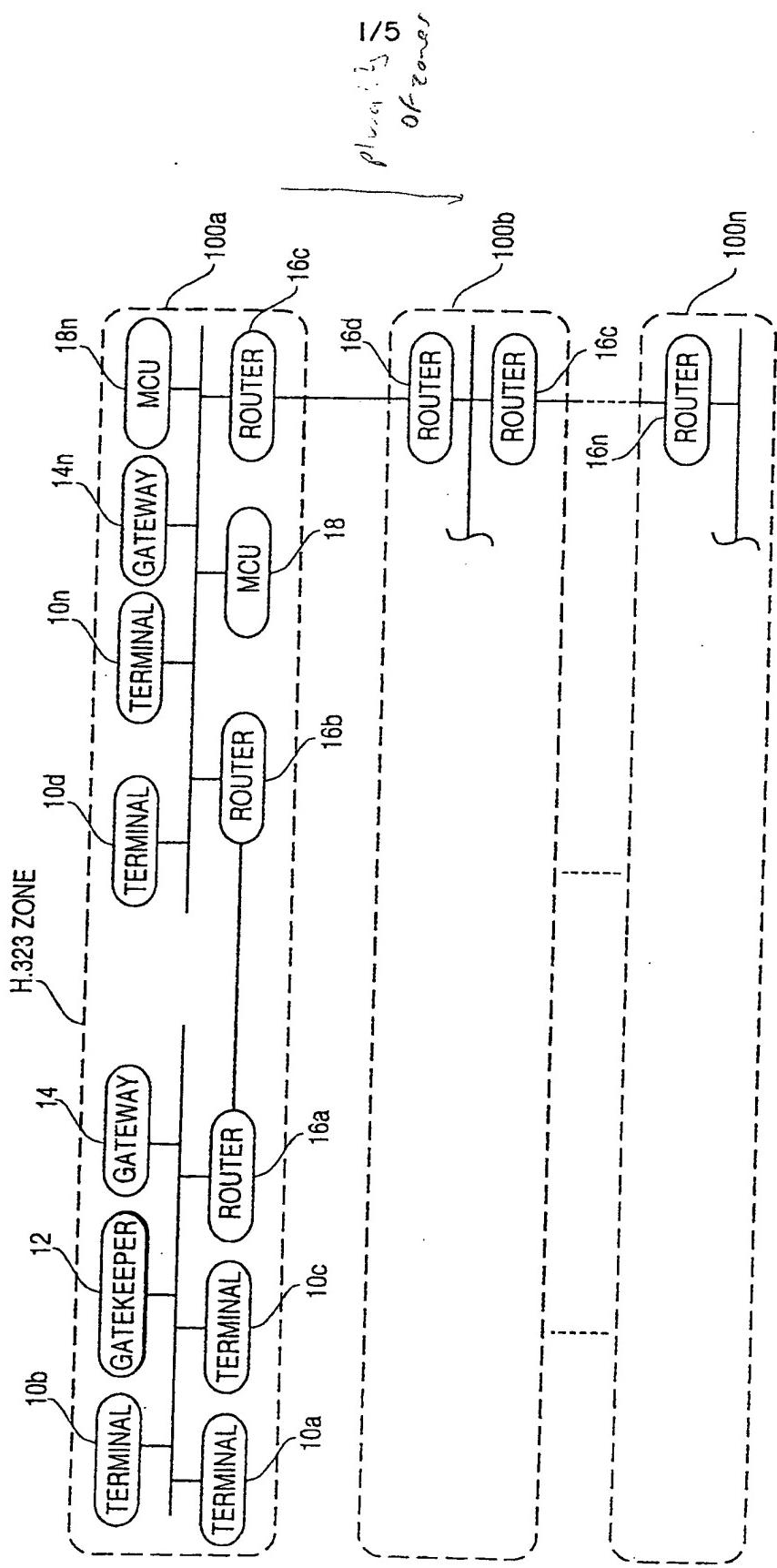
INTERNATIONAL SEARCH REPORT

Information on patent family members

Patent document cited in search report		Publication date	Patent family member(s)		Publication date
WO 9859467	A	30-12-1998	SE	513246 C	07-08-2000
			AU	7949998 A	04-01-1999
			SE	9702384 A	24-12-1998
EP 0964560	A	15-12-1999	NONE		

Interr ʜal Application No
PCT/US 00/17392

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication,where appropriate, of the relevant passages	Relevant to claim No.
Y	WO 98 59467 A (ERICSSON TELEFON AB L M ;FRISK CLAES (SE); KANTER THEO (SE); RYDE) 30 December 1998 (1998-12-30) abstract; figure 2 page 3, line 10 - line 25 page 8, line 15 -page 9, line 23; claim 4	3,6,10, 13,16, 20,23, 27,31
A	PERKINS C E: "MOBILE IP" IEEE COMMUNICATIONS MAGAZINE,IEEE SERVICE CENTER. PISCATAWAY, N.J,US, vol. 35, no. 5, 1 May 1997 (1997-05-01), pages 84-86,91-99, XP000657114 ISSN: 0163-6804 page 94, column 1; figure 10 page 92, column 2	3,6,10, 13,16, 20,23, 27,31
P,X	EP 0 964 560 A (NORTEL NETWORKS CORP) 15 December 1999 (1999-12-15) abstract; figure 1 page 5, column 7, line 35 -column 8, line 17; claim 1	1-32

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